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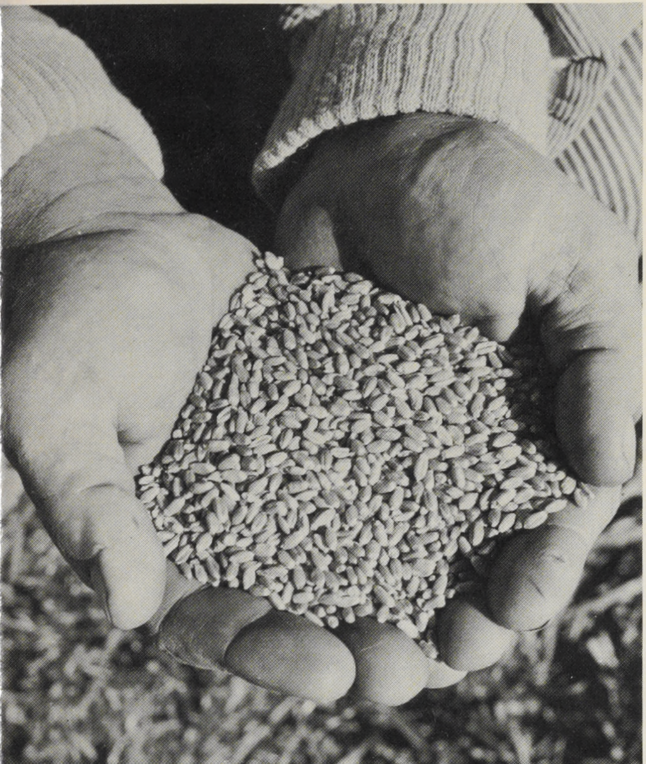
WESTERN CANADIAN GRAIN

The Farmlands and Farms of Western Canada



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ISSUED SEPTEMBER, 1964

THE CANADIAN WHEAT BOARD

WINNIPEG, CANADA

The Farmlands and Farms of Western Canada

INTRODUCTION

The purpose of this publication is to give readers in other parts of the world a general idea of the conditions under which grain is produced in Western Canada. It begins with a brief discussion of the natural features of the farming area, and from this it will be seen how hopes, based of the warm and glowing promises of spring, are rendered uncertain by the shortness of the growing season in the north, and low rainfall in the south.

Plant breeders have developed early-ripening grain varieties, resistant to late spring frosts, for the northern districts, and drought-resistant varieties for the dry areas. Farm practices designed to conserve soil moisture, and to minimize wind and water erosion, have also been established as a result of lessons learned from farming experience and the work done by various research agencies. As these practices are essential to the success of the grain producer they are briefly described.

Other hazards to grain production are plant diseases, insect pests, and weeds. Although these enemies are not peculiar to any one country, but are encountered wherever agriculture is practised, no account of farming in Western Canada, however short, could omit some reference to them and to the methods used for their control.

In the latter part of the bulletin, statistics are given to show what changes have occurred in the land area occupied by farms, and in farm numbers, farm sizes, and farm populations. Even as the record opens at the beginning of the present century, increases in the sizes of established farms were already taking place; and in more recent years this process has been so greatly accelerated, as a consequence of mechanization, that it is no exaggeration to say that farming has been revolutionized.

Larger farms, good roads, automobiles and trucks, have led to the organization of rural communities in larger units, with more widely dispersed towns as their business, educational and social centers. As always, change has brought loss as well as gain, and older farmers sometimes look back with regret on earlier days, when farming was thought of as "a way of life" rather than a business, and they themselves were knit more closely with their immediate neighbours. However, if the farmer now gets and spends like the urban dweller, his efficiency as a producer has been increased; the soil—his most important asset—is better managed; his former isolation has been relieved; and the amenities of his home approach those of city residences.

THE FARMING AREA

ALONG ITS SOUTHERN EDGE, the farming area of Western Canada extends for a distance of 800 miles. To the west, where the climate is mitigated by winds from the Pacific, grain is grown as far as 600 miles north of the United States border; but where the farming area meets the rock and forest of the Pre-Cambrian Shield at its eastern extremity, its width is only about 100 miles.

The area slopes downward to the east, and divides itself into three steppes or levels. The lowest of these, with an elevation of some 800 feet above the sea, lies wholly within the Province of Manitoba. Much of it was once the bed of a great glacial lake. A natural feature of agricultural importance and historical interest is the broad and fertile valley of the Red River, where wheat was sown by the first settlers as long ago as 1812. Towards the Saskatchewan border the land rises to the second steppe which stretches westward for about 300 miles at an elevation of some 1,700 feet. Here the rich farmland generally has an undulating profile as compared with the almost level plain through which the Red River slowly makes its winding way. The third steppe extends from the 2,000 foot level in the western part of Saskatchewan to the Alberta foothills where it rises sharply until, at Calgary, it reaches a height of 3,500 feet. Its surface, especially towards the west, is often more broken and irregular than that of the second steppe. The whole area forms a part of the great plain which occupies the middle of the continent from the Gulf of Mexico to the Arctic Ocean.

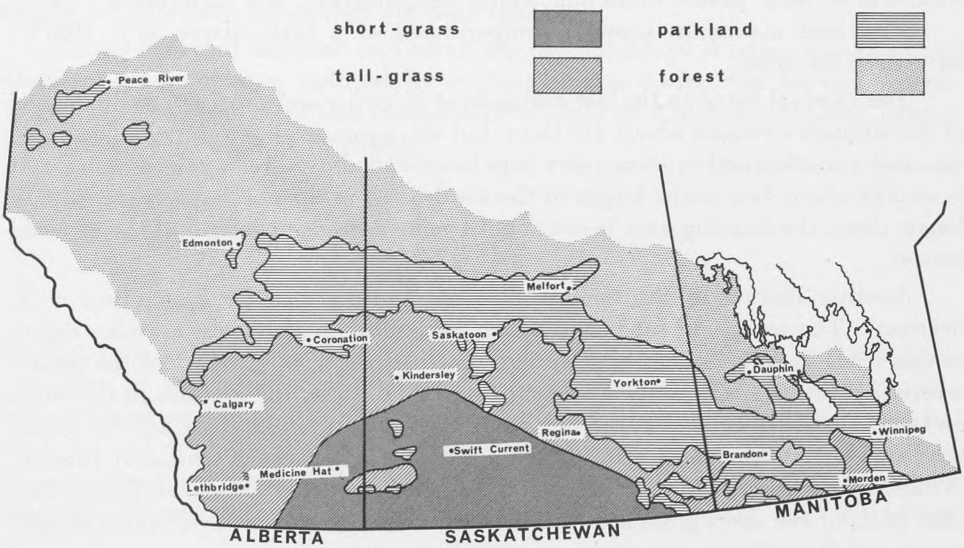


FIGURE 1—Map of the Prairie Provinces showing zones of natural vegetation.

NATURAL VEGETATION

THE AGRICULTURAL AREA can also be divided into three main zones on the basis of natural vegetation. A large part of it was once treeless grassland or prairie. As will be seen from Figure 1, this part comprises nearly the whole of the southern portion of Alberta and the adjacent area in western and central Saskatchewan, from which a narrow extension stretches into Manitoba. Towards the boundaries of the prairie region, except to the south, the grass cover is heavier than it is in the central portion. On the borders of the prairie lies the parkland zone. Here a more abundant vegetation and scattered groves of aspen and oak give a park-like appearance to the landscape. The parkland area forms a transition zone leading to the great boreal forest which extends to the arctic tundra. Within its southern fringes of conifers, birch and poplar we come to the present limits of the farming area.

CLIMATE

THROUGHOUT THE AGRICULTURAL REGION of Western Canada winters are severe and spring comes late, but long and sunny summer days promote the rapid growth of crops. In January, mean daily air temperatures range from −18°C (0°F) at Winnipeg to −9°C (15°F) in southwestern Alberta; and in July from 20°C (68°F) at Winnipeg to 17°C (62°F) at Calgary. But deviations from these means are very wide and at most points minimum winter temperatures of a little under −46°C (−50°F), and maximum summer temperatures of a little above 38°C (100°F) have been recorded.

The interval between the last killing frost in spring and the first one at the end of the summer averages about 115 days, but this again is subject to wide local and seasonal variation and in some years may be extended by three weeks or more. It is usually about two weeks longer in the south than in the north where, in spite of longer days, the farming area is restricted by the decreasing length of the growing season.

Another feature of the climate of great consequence for agriculture is its dryness. The mean annual precipitation over most of the grain growing region ranges from 14 to 20 inches of water. From the south-central part of the prairie where it is lowest, precipitation increases rapidly towards the foothills in the west, and more gradually towards the north and east. A hundred years ago the grassland area was judged to be unsuitable for settlement because of its scanty rainfall. While history has shown this judgement to be too sweeping, it is nevertheless true that parts of the short grass area are too arid for the profitable production of field crops, and that other parts can be successfully used for that purpose only if special measures are taken to conserve the available moisture.

About a quarter of the precipitation falls in the form of snow between the beginning of November and the end of March. Since much of this fraction runs off the frozen ground in the spring it is of little value for the production of crops. Fortunately there is usually a favorable distribution of the remaining precipitation. Most of it falls in June, July and August while the crops are growing. Sometimes, however, the rains fail to come when they are needed, or they come in insufficient quantity. In drought years the deficiency in soil moisture may be so pronounced and so widespread as to reduce the average yield of wheat for the country as a whole to about one-half of the long-term average.[1] And even the average for the last twenty-five years of 18.5 bushels per acre is very low compared with yields obtained in several other wheat growing countries.

The main reason for the low average yield is the general aridity of the region. During the later stages of its growth the wheat plant uses water in large quantities. This is especially true in the prairie section where high solar radiation during the growing season, the dryness of the air, and the prevalence of wind, all raise the rate at which moisture is transpired and evaporated. Under such conditions the roots of maturing wheat plants, which may extend to a depth of about five feet, remove every bit of available moisture from the soil, thus bringing the filling of the kernels to an end. There is, however, another side to this picture. The very conditions which bring about low yields, are also largely responsible for the high average protein content which helps to give Western Canadian wheat its special value in world markets.

Another reason for low average yields is the shortness of the growing season. Selection of grain varieties for earliness usually means that some sacrifice of yield per acre must be accepted. In the northern districts even early varieties may be caught by fall frosts before they are fully ripe.

In spite of what has been said about the dry climate of Western Canada, crop qualities are sometimes reduced by excessive rains during the harvest season. These may be so persistent that occasionally crops, over a considerable area, cannot be threshed before the snow comes.

SOILS

NATURAL SOILS are formed by highly complex physical, chemical, and biological processes in which disintegrated rocks, climatic factors, and living organisms interact with one another. The type of soil formed from given parent geological material will depend upon the environment and upon the length of time the soil-forming processes go on. When, about 10,000 years ago, the great ice sheets retreated from what is now the farming area of Western Canada, they left behind

1. Lowest average yields obtained during the last 30 years were: 8.1 bushels per acre in 1936; 6.4 bushels in 1937; and 10.6 bushels in 1961. The highest average yield was 26.7 bushels, obtained in 1952.

in all parts of the area deposits made up of clay, silt and sand out of which soils were slowly built. The main soil zones of the area did not become differentiated as a consequence of differences in the composition of the deposits, nor because of differences in the time of exposure to soil-forming agencies. Deposited materials and the time of their exposure were substantially the same from zone to zone, except to the east and west of Lake Manitoba where the glaciers left drift material that was high in limestone.

What brought about the differentiation of the main soil zones were comparatively small differences in climate, more especially in rainfall, but also in summer temperatures and wind intensity. These small differences caused variations in the nature and abundance of the vegetation which became established, and consequently of the vegetable materials returned each year to the soil. They also influenced the processes by which this vegetable material was transformed—by the activities of micro-organisms, mites and insects, and worms and other forms of animal life—into intermediate products called "humus", and finally into elementary plant nutrients, ready to enter once more the cycle of growth and decay. Decaying vegetable material does more than return its own elements to the soil. It traps plant nutrients from percolating water, increases the water-holding capacity of the soil, and has beneficial effects on soil texture and granulation—all of which influence the growth of later generations of plants.

The effects of environment are felt in other ways. During the process of soil building soil constituents are moved by various mechanisms. The root systems of plants transfer nutrients from lower to higher levels; insects and animals mix together the materials of the upper soil layers; and percolating water carries soluble substances and suspended particles of organic matter and clay from upper to lower

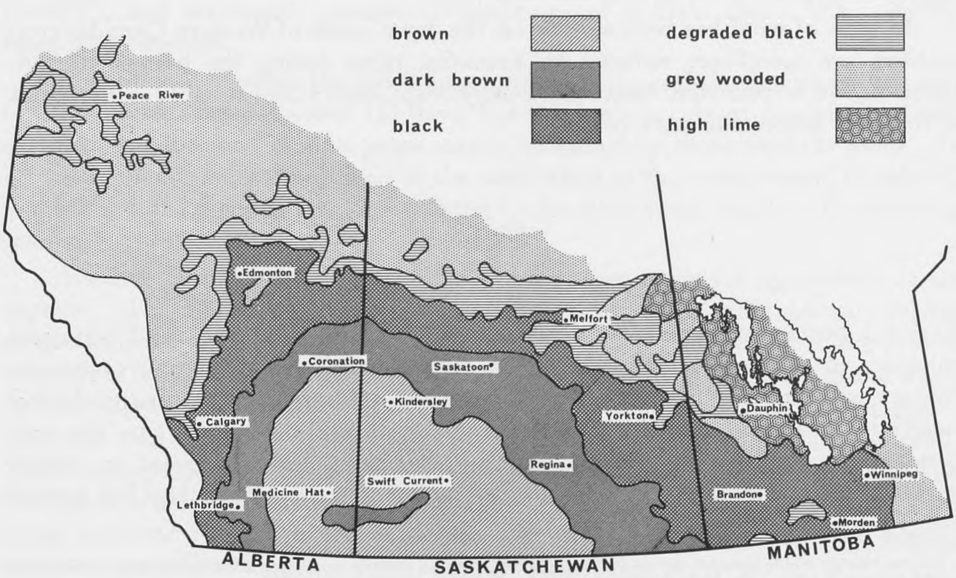


FIGURE 2—Map showing the main soil zones of the Prairie Provinces.

levels. All these soil-forming mechanisms are influenced by climate, especially by soil temperature and by the amount of water which enters the soil.

Differences in the composition and structure of soils arising from small environmental differences may well be imperceptible after a short period of time; but in Western Canada they accumulated for thousands of years and are now plainly exhibited as zonal differences in the color, depth and fertility of the main soil types.

The main soil zones are not as sharply defined as the Figure 2 suggests. One zone merges into the next through transition areas of varying width. Moreover, the soil is very far from uniform within any one zone. It may vary from heavy clay to loamy sand according to the parent material from which it was formed. Variations in parent material, important as they are in their direct effects upon soil texture, also have indirect and cumulative effects during soil development. This is because the proportions of clay, silt and sand in a soil markedly influence its ability to retain water and hold plant nutrients, and hence the abundance of the plant life it can support to participate in soil-building processes.

Drainage also plays a part in producing local variations in soils within a single main soil zone and even, indeed, within a single field. Water drains from slopes carrying with it soluble substances and suspended materials; and it accumulates in hollows and flat areas where its evaporation may result in the production of saline soil. Whether this occurs or not, insofar as topography affects soil moisture it will also affect, as already indicated, the end results of soil-forming processes. Thus, while the main soil zones were formed as a consequence of small differences in the environment, the numerous sub-zones arose as a result of local differences in parent materials and in drainage.

The main soil zones of the grain growing area of Western Canada are as follows:

The brown soil zone, which coincides quite closely with the short-grass prairie region, covers an area of some 34 million acres. The direct and indirect effects of the scanty rainfall led to the production of shallow soils containing relatively small quantities of organic matter per acre. Only the heavier soils are suitable for grain production; the others are used for cattle grazing.

The dark brown soil zone forms a belt surrounding the brown soils. It embraces an area of about 30 million acres. As a result of more favorable moisture conditions the native vegetation was heavier than in the brown soil zone and the soil formed was generally deeper, and richer in organic matter. A more diversified agriculture can be practised in this region and although light soils and high land must be used for grazing, the heavier soils usually produce good crops of wheat of very high quality.

The black soil zone corresponds to the parkland belt, where more humid conditions allowed the growth of tall grasses, herbaceous plants and trees. In this zone, which covers an area of approximately 43 million acres, the typical soils—dark brown to black in color—are deep, rich in organic matter, and very fertile. They are the best of the grassland soils.

The grey black soil zone forms a band of irregular shape to the north and west of the black soils. It is a transition zone between parkland and forest soils, and

its variable soils partake of the characteristics of both neighbours. The native vegetation consists mainly of trees interspersed with areas of tall grasses. Tree invasion has been encouraged by the cumulative effects of a slightly higher precipitation, and appreciably smaller moisture losses through evaporation and spring run-off. Under these conditions the surface layers of the deep black soils, formed under grass, are losing their humus through decomposition and leaching. They are often called "degrading black soils". Their fertility depends upon the extent to which they have been changed by leaching, but on the whole they are quite productive.

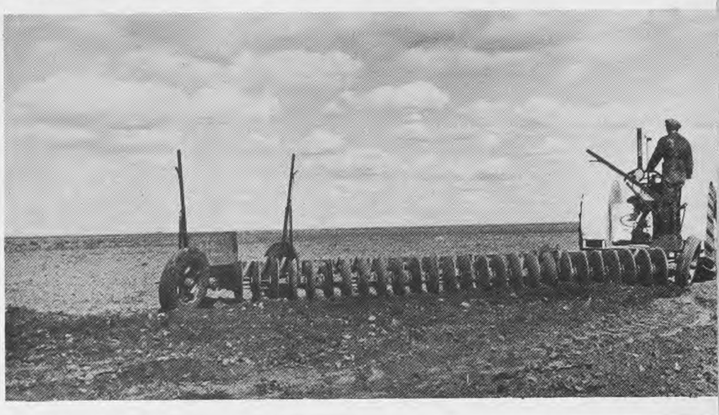
The grey wooded soil zone occupies a very large area in northern Alberta and smaller areas in the other two provinces. The typical undisturbed soil of this zone is found beneath a shallow cover of leaf mould, and consists of a dark layer, rich in humus but only an inch or two thick, lying on a greyish-colored layer which may be up to eight inches deep. The humus content of the grey layer is low, and moreover, as a result of hundreds or thousands of years of leaching by solutions from the upper level, some of its original geological materials have been decomposed and carried away. Changes brought about in this manner give the soil its grey color and its unsatisfactory physical properties.

As a consequence of their deficiencies in organic matter and plant nutrients—especially nitrogen, phosphorus and sulphur—the management of grey wooded soils requires the use of fertilizers and of crop rotations which include such legumes as clover and alfalfa. When well managed the soils are quite productive although the short, cool growing season makes this zone generally unsuitable for the production of high-quality wheat.

Using a moldboard plough on a Manitoba Farm.
MANITOBA DEPARTMENT OF AGRICULTURE AND CONSERVATION

Discing-seeding operations on a farm in southern Saskatchewan.
THE NATIONAL FILM BOARD OF CANADA

A one-way disc plough.
SASKATCHEWAN WHEAT POOL



Cultivating with a disc implement.
UNITED GRAIN GROWERS LTD.

A spring-tooth cultivator in operation, Rosetown, Sask. A trash cover is maintained to prevent wind erosion.
PRAIRIE FARM REHABILITATION ADMINISTRATION, CANADA DEPARTMENT OF AGRICULTURE

Flexible drag harrows being used to level and pack the soil south of Regina.
SASKATCHEWAN DEPARTMENT OF INDUSTRY AND INFORMATION

FERTILIZERS

Every Cereal Crop that is harvested removes nitrogen and other elements from the soil and, sooner or later, some of these plant nutrients must be restored if productivity is to be maintained. This is done in Western Canada, as elsewhere, by the use of farm manure, by growing legumes, and by the application of commercial fertilizers. The elements most likely to be deficient are phosphorus, nitrogen, and—in grey wooded soils—sulphur.

In the brown soil zone, where grain yields are limited by lack of moisture rather than by deficiencies in soil fertility, commercial fertilizers are not widely used except on the heavier soils with good reserves of moisture. In other soil zones fertilizers can generally be used with profit, although the amount of profit resulting from their use will be influenced by seasonal growing conditions and the quantity of humus in the soil as well, of course, as by grain prices. Any farmer can have soil samples tested at nominal cost, and readily obtain expert advice as to what fertilizer will give him the best returns, and the quantity that should be applied per acre.

Strip farming in Alberta.
PRAIRIE FARM REHABILITATION ADMINISTRATION, CANADA DEPARTMENT OF AGRICULTURE

A cultivated field near Regina, showing trash cover left to prevent erosion.
PRAIRIE FARM REHABILITATION ADMINISTRATION, CANADA DEPARTMENT OF AGRICULTURE

Fertilizers commonly sold in Western Canada provide either nitrogen alone or nitrogen and phosphorus in varying proportions. A very widely used fertilizer for crops on summerfallow is ammonium phosphate, containing 11% nitrogen and 48% phosphorus pentoxide. It is usually applied at the rate of 40 to 50 pounds per acre. For crops on stubble land where more nitrogen is needed, mixtures of ammonium phosphate with ammonium sulphate (21% nitrogen), or ammonium nitrate (33.5% nitrogen), are frequently selected. Ammonium sulphate is also used on grey wooded soils as a source of sulphur.

When the mixtures referred to are used to supply up to 25 pounds of nitrogen per acre they are drilled into the soil during the seeding operation. This is also done when ammonium phosphate is used by itself. Applied close to the seed by means of a special attachment on the seeding equipment, the fertilizer is most readily and efficiently taken up by the plants to promote rapid root development and vigorous growth. The plants are thus better able to compete with weeds and to withstand certain diseases. They also ripen earlier and produce larger yields of grain, as well as more straw to increase the humus content of the soil. That farmers have come to recognize the benefits to be obtained from the judicious use of fertilizers is shown by the fact that fertilizer sales in the prairie provinces rose from 55,000 tons in 1954-55, to 290,000 tons in 1962-63.

Seeding on irrigated land at Hays, Alberta.
PRAIRIE FARM REHABILITATION ADMINISTRATION, CANADA DEPARTMENT OF AGRICULTURE

WIND EROSION

EROSION OF SOIL by wind is a serious threat to the farmlands of Western Canada. The danger is greatest in spring when the fields are bare and is magnified in dry periods; but it is a menace which cannot safely be forgotten at any time. The worst effect of erosion is the reduction in soil fertility resulting from the loss of small particles of organic matter, clay and silt. The lightest of these are carried away for long distances as great clouds of dust, but most of the damage is done by the movement of heavier particles in a jumping or saltatory motion. They are picked up by the turbulent air at the soil surface and carried for short distances at a height of a few inches before they strike the ground again, often with considerable force. Still larger particles, too heavy to be lifted, are rolled over the surface in movements imparted by the impacts of particles in saltation. The impact of moving particles on clods too heavy to be shifted produces, by abrasion, more particles fine enough to be lifted into the dust cloud, or moved by saltation and creep. Thus erosion grows more severe as it progresses across a wide field, and when at length the moving soil is halted, it forms drifts which fill ditches, choke roads, smother vegetation and damage buildings.

The nature of erosive action by wind provides a key to an understanding of the control methods that are applied. Among these are measures to ensure that soils are rich in decomposing vegetable material, since this material causes aggregation of the soil into small granules which resist movement and attrition. Erodibility is also reduced by the use of tillage methods which, so far as possible, produce clods too large to be moved by particles in saltation, yet small enough to provide the maximum surface to cover movable particles in the soil.

Stubble and straw, anchored to the soil as a trash cover by suitable tillage methods, afford protection by reducing wind velocities at ground level and by trapping moving soil particles. The trash is eventually converted into humus with beneficial effects on soil structure.

In areas susceptible to soil drifting, narrow strips of land laid out at right angles to the prevailing wind are used as fields in crop rotations. Depending upon the character of the soil and the moisture situation at the time, these strips may be anywhere from 50 to 200 yards wide. Each strip of vegetation reduces the wind speed at ground level, and by arresting the motion of saltating particles prevents the acceleration of erosion which occurs when wind sweeps unimpeded across a wide field. Sometimes shelter belts of trees are preserved or planted for the purpose of breaking the wind.

Finally cover crops and systems of crop rotation are used to limit as far as possible the exposure of bare unprotected fields and to maintain an erosion-resistant soil structure. Wherever a combination of all feasible methods fails to give control, the only safe thing left to do is to return the land permanently to grass. The prevention of wind erosion is far better than any cure, for once begun it is likely to spread.

Seeding-discing in southern Saskatchewan.
THE NATIONAL FILM BOARD OF CANADA

WATER CONSERVATION AND CROPPING SYSTEMS

Owing to the Low Average Rainfall, the need for moisture conservation has been an important consideration in deciding the cropping systems used in Western Canada. This is especially true of the brown soil zone and to a lesser degree of the dark brown soil zone. The lighter soils of these zones are most liable to wind erosion, and it is on these soils that crop failures due to moisture deficiencies are also most frequent. Experience has shown that such soils are best seeded to grass. The better soils, however, can be successfully used for grain production and for pasture and forage crops, providing care is taken to conserve the available moisture. Conservation methods will vary in detail according to the nature of the particular soils and to prevailing moisture conditions.

The practice of summerfallowing is an essential feature of grain farming on the better brown soils. Part of the precipitation falling on a field that lies fallow for a year is stored in the soil as a moisture reserve for use by the next crop and may spell the difference between its success and failure. To prevent losses of stored moisture the fallow land has to be kept free from weeds, and this must be accomplished by tillage methods which minimize the risk of wind erosion, or alternatively by spraying with herbicides.

Choice of crops in the brown soil zone is limited. Although other grains, especially rye, may be grown, the main crop is wheat and the most common rotation is wheat-fallow. Under favorable moisture conditions wheat may be grown for two years in succession. On the dark brown soils the rotation, wheat-wheat-fallow is quite usual; and here grass-legume mixtures, and in some areas, winter wheat, may be sown as alternative crops in addition to the more usual oats, barley, rye and flax.

Wheat fields and grain elevators at Indian Head, Sask.
THE NATIONAL FILM BOARD OF CANADA

The usefulness of a trash cover as a means of preventing wind erosion has already been mentioned. Such a cover also conserves moisture and prevents soil losses by water erosion. The stubble facilitates entry of water into the soil and, during rapid thaws or heavy rainstorms, restrains surface water from running off sloping land, carrying with it fine soil particles. Losses of precious water and soil from sloping fields are also minimized by plowing, cultivating and strip cropping across the slopes.

These techniques in soil management and land use, growing out of harsh experience and scientific studies, have markedly increased the stability of agriculture in dry areas. Other methods of utilizing the limited water resources have also helped to bring greater security to many farmers. On many thousands of farms run-off water is now collected in dugouts or impounded by small dams, and from these reservoirs it is pumped for household purposes, watering stock, and sprinkling gardens or small fields. Portable pumping units are sometimes used to lift excess water from lower to higher crop land, thus increasing the productivity of both. And, finally, a number of irrigation works, with dams, reservoirs, canals, and ditches have been built since the beginning of the present century, and others are under construction. Some of these are large, some small. Already some 900,000 acres are under irrigation in Alberta and Saskatchewan; and works now exist, or are under construction, to provide for the irrigation of an additional 750,000 acres. Included in these works is the South Saskatchewan River Development Project which, when completed, will constitute a vast water control system to irrigate 200,000 acres of farmland situated in an area of quite low rainfall.

In the black soil zone, where moisture conditions are more favorable for crops, there is less need to leave land unproductive for one year out of two or three. Summerfallowing is still practised but in a longer rotation, and then often as much for weed control as to conserve moisture. In many parts of this zone a mixed farming type of rotation is most effective in promoting maximum productivity. Barley and oats occupy a larger place in relation to wheat than they do in the drier areas, while grasses and legumes are grown for pasture and for hay, as well as for soil improvement and erosion control.

According to local conditions, farming practices in the grey black soil zone range from those followed in the black soil zone to those which have been found most suitable for the grey wooded soils. The latter, deficient in organic matter and essential plant nutrients, soon deteriorate on a grain-fallow rotation, but under good management their physical characteristics can be improved and their fertility and productivity increased. This is accomplished by the application of manure and fertilizers and by growing soil-improving crops such as alfalfa and clovers, either alone or in combination with grasses. A common rotation is two or three years of legume, or legume and grass, followed by two or three years of grain. Barley and oats are better adapted than wheat to growing conditions in this soil zone. Wheat, which requires a longer growing season, is frequently damaged by frost. The poorer grey soils are given over to the production of forage crops and livestock.

PLANT DISEASES, INSECT PESTS AND WEEDS

PLANT DISEASES, insects and weeds all take their toll of the crops in Western Canada, just as they do in every other grain-producing country. Little will be said about these enemies here, not because they are unimportant, but because the methods by which they are kept under control are not peculiar to Western Canada.

Plant Diseases. Since earliest times ceral crops have been subject to various diseases whose famine-threatening visitations were once regarded as expressions of the displeasure of the gods. It is now known that each disease—rust, smut, root-rot, or whatever it may be—is the result of infection by some particular micro-organism. Each infective agent is usually, though not invariably, quite specific in its parasitic behaviour; that is to say it produces a particular disease in one, and only one, sort of cereal grain.

Members of one group of fungi cause the stem rusts of cereal plants. The disease is spread by wind-blown spores, and in certain seasons has been responsible for heavy losses in Western Canada. It was estimated that in 1916 stem rust reduced wheat production by 100,000,000 bushels, and, in 1954, by 150,000,000 bushels. There have been other years of heavy losses, but these two were the worst. Severe losses have also been caused by oat stem rust.

At present the only effective way to combat the disease is to breed varieties of grain resistant to infection.[1] The breeding problem, however, is complicated by the fact that there are numerous strains of the stem rust organism to which different varieties of the host plant react differently. One variety of grain may be resistant to strains of stem rust to which another variety is susceptible. An even more serious difficulty arises because new strains of the fungus can be formed by hybridization and mutation. The particular strain of stem rust responsible for the outbreak which caused such a heavy loss in 1954, was completely unknown in 1939 and did no appreciable damage before 1950. The capacity of stem rust organisms to produce variant forms means that no final solution of the rust problem is yet in sight. Canadian plant scientists have scored some notable successes in breeding rust-resistant varieties of wheat and oats, yet they are only too well aware that these successes do not guarantee security. A new strain of rust may appear next year to which our present varieties of wheat or oats will be vulnerable.

What has been said about stem rust applies equally well to leaf rust, and in part to the smuts and root rots. One of the chief aims of any breeding program is to produce a variety of grain resistant to as many of these infectious diseases as possible, but inevitably some compromises have to be accepted. Some degree of susceptibility to smuts and root rots can be tolerated in order to gain resistance to the potentially far more destructive rusts. Reconciliation to what is possible in this respect is made less difficult by the fact that there are other modes of defence against smuts and root rots.

1. See Canadian Wheat Board Bulletin No. 1.

Swathing wheat near Milestone, Sask.
THE NATIONAL FILM BOARD OF CANADA

Swathing wheat. Kronau, Sask.
SASKATCHEWAN DEPARTMENT OF INDUSTRY AND INFORMATION

Combines in a field at Riceton, Sask. Each combine picks up two swaths which have been laid side by side.
SASKATCHEWAN DEPARTMENT OF INDUSTRY AND INFORMATION

Swathed grain in a field well protected by shelter belts. Conquest, Sask.
PRAIRIE FARM REHABILITATION ADMINISTRATION, CANADA DEPARTMENT OF AGRICULTURE

Threshing swathed grain in Manitoba.
MANITOBA DEPARTMENT OF INDUSTRY AND COMMERCE

A self-propelled combine at work in a Manitoba field.
MANITOBA DEPARTMENT OF INDUSTRY AND COMMERCE

Threshing with a pull-type combine on a farm in Manitoba.
MANITOBA DEPARTMENT OF INDUSTRY AND COMMERCE

Some smut diseases are caused by fungi carried on the seed; others by fungi carried within the seed. Surface-borne fungi can be controlled by treating the seed with a fungicide, while destruction of fungi within the seed is accomplished by treating the seed with hot water or, more simply, by immersing it in water for two hours and then holding it for a day in air-tight containers. Smut-free seed is also readily obtainable from seed dealers.

In unfavorable seasons root rots cause considerable losses of wheat and barley in some areas. After wintering in the soil and on the trash cover, the root rot organisms infect the young seedlings and may either weaken or destroy them. The first line of defence against root rots, as against smuts, is to screen out the more susceptible hybrids produced in cereal breeding programs. If despite this, root rot should become troublesome in certain places, additional protective measures must be taken. Most important of these is to adopt crop rotations which include summerfallow, oats, flax and legumes, and to avoid growing wheat and barley for two years in succession on the same land. Treatment of the seed with a fungicide, and the use of fertilizers to stimulate seedling vigor have also been found useful in the control of root rots.

A discussion of the less important diseases of the main cereal crops, and of the diseases of other crops such as flax, rape and sunflower, is beyond the scope of this bulletin.

Insects. The chief insect pests of crops in Western Canada are the wheat stem sawfly, wireworms, cutworms, and grasshoppers.

The wheat stem sawfly, which may attack a few varieties of barley as well as wheat and spring rye, lays its eggs inside the plant stems where the larvae feed on nutrients which would normally reach the head of the plant. Just before harvest they cut the stems from the inside near ground level and remain as cocoons in the stubs until spring.

In the dry prairie area where the sawfly is most troublesome, wheat varieties are now available which, under normal conditions, grow with solid stems and are immune from attack. In other areas immune crops such as oats and flax, or highly resistant varieties of barley, may be grown; or the insects may be destroyed through exposure of infested stubble by shallow tillage; or infested fields may be quarantined and susceptible crops protected by means of surrounding barriers of immune crops.

Wireworms, which have a life span of up to ten years, attack all cereal crops, but more especially wheat and spring rye. They are particularly troublesome in light prairie soils. Infestations may often be held in check by periodic summer-fallowing and keeping the fallow land clean in order to destroy the food supply of the long-lived larvae. When immediate and effective control is wanted, infested fields are sown with seed treated with an insecticide. One such sowing brings about a very marked reduction in the number of larvae in the soil and will usually not need to be repeated for a few years at least.

Cutworms attack the young plants of all crops. Any large increase in the cutworm population in a particular district can usually be foreseen, since it requires weather favorable for the survival and propagation of the insects during the

preceding summer. Farmers can thus be forewarned of impending outbreaks and take appropriate protective measures. One such measure is to starve the young cutworms in fields that are to be seeded. Immediately after the larvae start to feed in the spring the fields are cultivated to destroy all green growth. If seeding is then done a week or two later, lack of food will have depleted the insect population before the new plants emerge. On summerfallow, tillage is used to produce soil surfaces which are unfavorable for egg laying by the moths in the late summer. Finally, whenever cutworm damage is observed the recommended practice is to spray the field with an insecticide.

Grasshoppers lay their clusters of eggs in the soil during the late summer and these hatch in the spring. Grasshoppers have many natural enemies, but from time to time, now in this area and now in that, they become numerous enough to constitute a serious threat to crops. Fortunately, as with cutworms, entomologists are able to issue warnings of threatened outbreaks in plenty of time to allow farmers to plan their operations, ready their equipment, and obtain supplies of chemicals.

Crops sown on clean summerfallow are unlikely to suffer damage provided their margins are protected from grasshopper invasion. Infested stubble fields, however, should be left fallow and tilled to keep them quite free from green growth while the insects are hatching. Wherever grasshoppers appear—in crops, pastures, stubble land or the green borders of fields and roads—they can now be quickly destroyed at relatively small cost by the use of recommended insecticides applied in the form of sprays, dusts, or baits.

Weeds. Weeds cause losses to the farmer in many ways, but the harm they do on the prairies arises mainly because they rob the crops of moisture. Weed control is thus an important feature of water conservation. Tillage is the oldest and still the most widely used method of controlling weeds. The timing of the operation, the depth of tillage, and the choice of implements used, all require the exercise of good judgement, and even then tillage often increases the risk of wind and water erosion through its adverse affects on soil structure, and its partial destruction of the trash cover. Tillage must therefore often be used in combination with other measures, such as the timely application of selective herbicides, the sowing of barley and rye as competitive crops, and seeding fields to forage crops. In 1963 over 25,000,000 acres in the Prairie Provinces were sprayed with herbicides to control weeds.

THE FARMS

We Shall Now Turn our attention from the environmental factors which govern Western Canadian agriculture to a brief study of the farms themselves. For this purpose we shall make use of the census data published in Ottawa by the Dominion Bureau of Statistics.

The total land area of the Prairie Provinces—Manitoba, Saskatchewan and Alberta—is about 436 million acres, or some 680,000 square miles. Most of this land is quite unfit for agriculture and in 1961 less than one-third of it, or about 130 million acres, was occupied by farms. However, the farming area still continues to grow, though now relatively slowly, as authorities satisfy themselves that public land, reasonably close to existing communities, is suitable for settlement. Such growth is taking place mainly in the northern wooded areas.

How the farming area increased between 1901 and 1961 is shown in the following table:

Table I

AREAS IN FARMS
(in millions of acres)

1901	1911	1921	1931	1941	1951	1961
15.4	57.6	87.9	109.8	120.1	123.9	129.8

The area occupied by farms is classified, according to its use, as either "improved" or "unimproved" land. Improved land consists of land under crops, land that has been cultivated and seeded to pasture, and land under summerfallow, as well as barnyards and home gardens on farms; unimproved land is made up of woodland, natural pasture and waste land. In 1961, 62% of the total farm area was classified as improved land.

Table II shows the number of farms in each census year, a farm being defined as "an agricultural holding of one acre or more, with sales of agricultural products during the previous twelve months of $50 or more."

Table II

NUMBERS OF FARMS

1901	1911	1921	1931	1941	1951	1961
55,176	198,933	255,657	288,079	296,469	248,716	210,442

Great changes occurred not only in the numbers of farms but also in their average size:

Table III

AVERAGE FARM SIZE
(acres)

1901	1911	1921	1931	1941	1951	1961
279	290	344	381	405	498	617

Classification of all farms by size, as is done in Table IV, shows that between 1941 and 1961 the number of farms larger than 639 acres increased at the expense of farms smaller than 480 acres. The number in the latter group was cut almost in half—from 209,998 to 108,113.

Table IV

FARMS OF THE PRAIRIE PROVINCES
CLASSIFIED BY SIZE

Acres	1941	1951	1961
1 - 4	1,860	1,668	1,073
5 - 10	2,941	2,906	1,540
11 - 50	6,011	4,800	3,247
51 - 100	7,714	4,940	3,458
101 - 200	96,170	52,787	31,674
201 - 299	11,359	11,272	9,188
300 - 479	83,943	74,216	57,933
480 - 639	35,970	36,506	33,246
640 - 959	32,806	35,909	37,988
960 - 1,279	9,555	12,281	15,253
1,280 and over	8,140	11,431	15,842
Totals	296,469	248,716	210,442

No attempt will be made here to tell once again the story of the settlement of Western Canada. It will be sufficient simply to say that settlers came to this nearly empty land in a great tide, which began to flow towards the end of the 19th century and continued until about 1930. From 1901 to 1931 the population of the Prairie Provinces rose from 420,000 to 2,354,000 and then remained almost stationary during the following years of economic depression and war. Figures showing the growth of the population are given in Table V.

A prairie harvest scene of bygone years.

Farms in the Red River Valley.
MANITOBA DEPARTMENT OF INDUSTRY AND COMMERCE

A Manitoba farm.
MANITOBA DEPARTMENT OF INDUSTRY AND COMMERCE

The experimental farm at Indian Head.
PRAIRIE FARM REHABILITATION ADMINISTRATION, CANADA DEPARTMENT OF AGRICULTURE

TABLE V

TOTAL POPULATION OF PRAIRIE PROVINCES
(millions of persons)

1901	1911	1921	1931	1941	1951	1961
0.42	1.33	1.96	2.35	2.42	2.54	3.18

Although the total population increased by 825,000 between 1931 and 1961, the farm population declined as shown in Table VI.

TABLE VI

FARM POPULATION OF PRAIRIE PROVINCES
(millions of persons)

1931	1941	1951	1961
1.20	1.15	0.96	0.77

In 1961 only one-quarter of the total population lived in dwellings situated on farms, as compared with one-half the total population in 1931.

Free land was the prize which brought settlers to Western Canada. Each was granted a homestead of 160 acres of which he could become the legal owner by cultivating a specified number of acres—or by carrying out certain alternative duties within a limited period of time. But in many cases it was soon found that an area of 160 acres was insufficient to provide a living for a farm family, and accordingly each settler was allowed to pre-empt an additional 160 acres of public land, which was sold to him at a very low price on easy terms. Thus, even in those early years, while more and more farms were being rapidly established, farm units were already beginning to grow larger.

In recent years the establishment of new farms and the growth in size of existing farms have occurred under conditions far different from those prevailing in the early part of the century. No longer was land plentiful or cheap and, as a rule, the only way to enlarge a farm was by buying or renting a neighbouring farm. As indicated in Table IV this process of absorption has been taking place so rapidly that, in spite of the continued establishment of new farms on virgin land, the total number of farms has sharply declined.

The decline in the number of farms (Tables II and IV), the increase in average farm size (Table III), and the decrease in farm population (Table VI), are indices of the effects in Western Canada of the revolutionary changes which are going on in agriculture. These changes were made possible by advances in science and technology. They were generated by pressures to increase the quantity, improve the quality, and reduce the unit costs of agricultural products; and in Canada they have been hastened by a great industrial expansion which brought about a scarcity and raised the cost of farm labor.

Better farming techniques, better farm management, superior varieties of seeds and of strains of livestock and poultry, the wider use of fertilizers, and the availability of more effective insecticides, herbicides, and fungicides—all these have

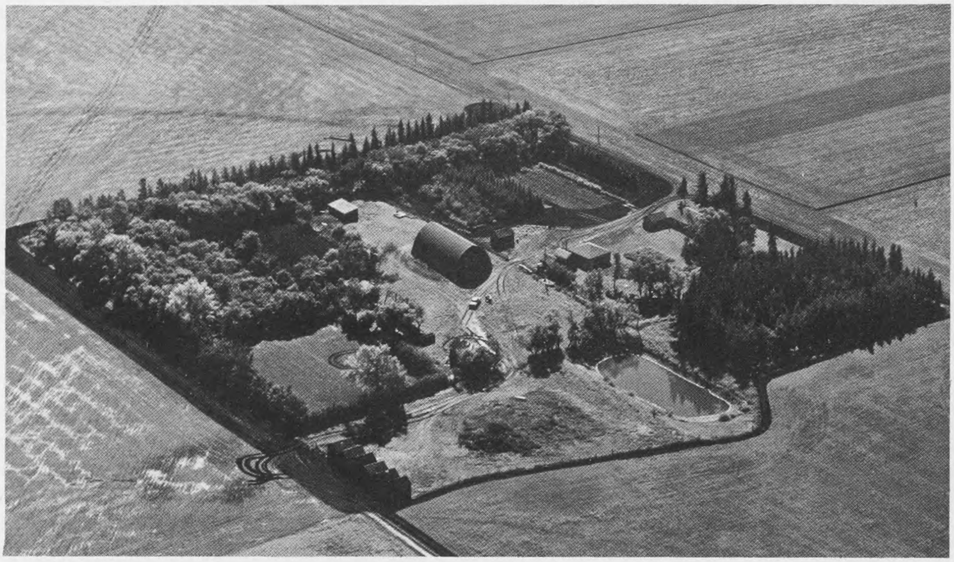
helped to increase the productive capacities of farm workers. But undoubtedly, what has done most to enable a smaller work force to increase total production has been the expanding use of farm machinery driven by petroleum fuel and, to a much lesser extent, the farm use of electric power. Some idea of the extent to which farm mechanization has been carried out in the Prairie Provinces can be gathered from the data in Table VII.

TABLE VII

NUMBERS OF FARM MACHINES IN USE

	1941	1951	1961
Automobiles	128,257	141,337	158,938
Motor trucks	43,363	113,512	185,983
Tractors	112,624	236,930	290,700
Grain combines	18,081	79,117	127,276
Grain binders	......	159,924	75,199
Swathers	....	....	95,702
Threshing machines	44,218	43,414	30,242
Pick-up hay balers	....	....	41,498
Forage crop harvesters	....	....	4,663
Electric motors	5,232	52,486	201,978
NUMBER OF FARMS REPORTING:			
Milking machines		8,470	17,191
Electric power		64,130	153,643

A Saskatchewan farmstead, showing a dugout for collecting run-off water and shelter belts of trees.
PRAIRIE FARM REHABILITATION ADMINISTRATION, CANADA DEPARTMENT OF AGRICULTURE



The estimated dollar value of farms in the Prairie Provinces rose very materially between 1941 and 1961 as shown in Table VIII.

TABLE VIII

TOTAL FARM VALUES
(in millions of dollars)

	1941	1951	1961
Land and buildings	1,378	2,727	4,291
Machinery and equipment	318	1,147	1,510
Livestock and poultry	250	824	935
	1,946	4,698	6,736

These large figures become a little more meaningful if they are divided by the numbers of farms:

TABLE IX

VALUE OF "AVERAGE FARM"

	1941	1951	1961
Land and buildings	$4,648	$10,965	$20,393
Machinery and equipment	1,072	4,613	7,174
Livestock and poultry	845	3,312	4,442
	$6,565	$18,890	$32,009

The estimated market value of the machinery and equipment in use on the average farm had risen to more than $7,000 in 1961—or nearly seven times as much as it had been twenty years earlier.[1] Purchases of newer types of equipment of increasing size and power for tilling, seeding, harvesting, and other operations, made it possible for an operator to farm more land. Often, indeed, he was driven to acquire more land in order to make more efficient use of his machinery and to earn a return on his rising capital investment. Thus, as machine power increased, so did the size of the economic farm unit, and so did the movement of the farm population to expanding industries in urban centres. Rising capital costs also had other effects. In particular they made it more and more necessary to operate a farm as a business enterprise—with emphasis on good management, and on the application of up-to-date knowledge based on research conducted by agencies of the federal and provincial governments, by universities and experimental farms.

Some measure of the productive capacities of the farms in the Prairie Provinces is provided by the following three-year record of farm cash incomes. Also shown are the values of the individual commodities or groups of commodities that were sold to yield these revenues.

1. See also Appendix 2.

An Alberta prairie scene with the Rocky Mountains in the distance.
ALBERTA DEPARTMENT OF INDUSTRY AND DEVELOPMENT

TABLE X

ESTIMATED CASH INCOME FROM FARMING OPERATIONS IN MANITOBA, SASKATCHEWAN AND ALBERTA[1]
(thousands of dollars)

PRODUCT	1961	1962	1963
	(Revised)	(Revised)	(Preliminary)
Wheat	555,205	665,542	711,278
Oats	23,967	28,334	36,256
Barley	64,055	74,359	66,029
Rye	4,722	8,580	7,556
Flaxseed	48,711	46,593	35,380
Rapeseed	17,047	10,127	11,715
Potatoes	3,068	3,713	3,507
Vegetables	2,821	3,236	4,112
Other crops[2]	27,594	25,248	36,193
Total Crops	747,190	865,732	912,026
Cattle and calves	318,608	328,470	291,944
Hogs	121,769	116,957	96,121
Sheep and lambs	5,624	4,770	4,319
Dairy products	99,484	98,168	98,806
Poultry	38,347	32,688	38,978
Eggs	28,003	27,671	29,323
Other livestock and products[3]	15,007	13,774	15,478
Total livestock and products	626,842	622,498	574,969
Forest products	1,120	1,150	1,150
Total cash income from farming operations	1,375,152	1,489,380	1,488,145

1. From data published by the Dominion Bureau of Statistics.
2. Includes hay and fodder, sugar beets, greenhouse and nursery products, fruits, forage seeds.
3. Includes horses, wool, honey and beeswax, fur-bearing animals.

Taken at their face value, the data in Table X give a misleading impression of the stability of farm incomes. In actual fact 300 million dollars of the cash income for 1961 was obtained by depleting farm stocks of grains and livestock. It was almost exactly the opposite in 1963, when grains and livestock to the value of over 300 million dollars were accumulated. When these and other adjustments are made, the effect of the severe drought in 1961 is revealed. As will be seen from the data in Appendix I, the *net* income in 1961 was well under half of what it was in the two following years, clearly bringing out the economic uncertainties inseparable from farming in an area where marginal climatic conditions are approached.

Table X was introduced to enable the reader to form an estimate of the present productive capacity of the farms in the Prairie Provinces. It also serves to convey some idea of the diversity of their products. Western Canada is known to many only as a wheat producer, yet not more than 44% of the "commercial farms"[1] listed in the 1961 census were classified as wheat farms, i.e., farms whose sales of wheat brought 51% or more of their total sales revenues. Many other crops contribute materially to farm incomes, and it is not generally realized, even in Canada, how large a place livestock occupy in the agriculture of its western provinces. During the period covered by Table X, returns from the sales of livestock and livestock products averaged more than 600 million dollars a year and constituted 42% of the total cash income from farming operations. Nevertheless, although wheat is only one of many products, it still remains by far the largest single source of income for prairie farmers, and still continues to hold its pre-eminent position as an export product of Canadian agriculture.

1. See Appendix 2.

A ranch in the foothills west of Calgary.
ALBERTA DEPARTMENT OF INDUSTRY AND DEVELOPMENT

Feeding dairy cows. Lacombe, Alberta.
ALBERTA DEPARTMENT OF INDUSTRY AND DEVELOPMENT

Baling cereal hay, south-central Alberta.
ALBERTA DEPARTMENT OF INDUSTRY AND DEVELOPMENT

APPENDIX I

FARM NET INCOMES

To arrive at net incomes from farming operations, the following adjustments have to be made to the total cash income figures shown in Table X:

(A) Add "Income in Kind", representing the value of the home produce consumed in farm homes and also the estimated rental value of farm homes.

(B) Add payments, under the Prairie Farm Assistance Act, to farmers in areas where production was abnormally low.

(C) Adjust for annual changes in the value of grains and livestock on farms.

(D) Deduct all operating costs, and also depreciation on buildings and machinery.

These adjustments are made in Table XI.

TABLE XI

NET INCOME FROM FARMING OPERATIONS IN THE PRAIRIE PROVINCES[1]
(in thousands of dollars)

	1961	1962	1963
Cash income (Table X)	1,375,152	1,489,380	1,488,145
Add (A) (above)	114,366	116,551	122,266
Add (B) (above)	35,274	70,013	14,740
	1,524,792	1,675,944	1,625,151
Adjust for (C) (above)	−307,910	+158,104	+323,840
	1,216,882	1,834,048	1,948,991
Deduct (D) (above)	781,679	836,899	889,092
Net income	435,203	997,149	1,059,899

1. As reported by the Dominion Bureau of Statistics.

Dairy cows on the farm at Lacombe.
ALBERTA DEPARTMENT OF INDUSTRY AND DEVELOPMENT

A farmstead at Lacombe, Alberta.
ALBERTA DEPARTMENT OF INDUSTRY AND DEVELOPMENT

APPENDIX 2

COMMERCIAL FARMS

Classification by economic status of prairie farms counted in the 1961 census produces the following grouping:

Commercial farms	174,505
Part-time and other small-scale farms	35,521
Institutional farms	416
	210,442

Farms are classified as "commercial" farms if, during the preceding twelve months, they sold agricultural products valued at $1,200 or more. In 1961 the average area of a commercial farm was 670 acres and its average market value was estimated to be:

Land and buildings	$ 22,820
Machinery and equipment	8,180
Livestock and poultry	5,090
	$ 36,090

Most commercial farms were operated by their owners as the following figures show:

Number of farms owned by operators	93,220
Number of farms rented by operators	15,075
Number of farms partly owned and partly rented by operators	65,650
Number of farms operated by managers	560
	174,505

CONVERSION FACTORS

Canadian Unit	Factor	Metric Equivalent
inch	x 2.54	centimeters
foot	x 0.3048	meters
mile	x 1.6093	kilometers
acre	x 0.4047	hectares
square mile	x 2.59	square kilometers
pound (lb.)	x 0.4536	kilograms
bushel of wheat	x 27.216	kilograms
bushels of wheat per acre	x 0.6725	quintals per hectare

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FRONT COVER—A Saskatchewan farmer displays a sample of his newly-threshed wheat.
THE NATIONAL FILM BOARD OF CANADA

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